Propriétés microphysiques des nuages bas et brouillards. Mesures in-situ sous ballon et télédétection

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OBJECTIFS – ENJEUX

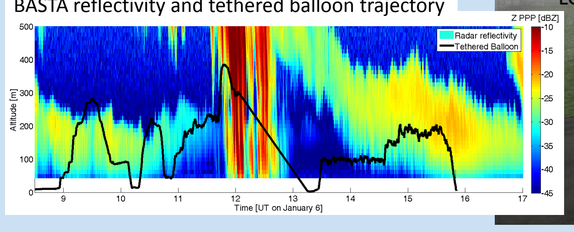
L'objectif de ce travail est de documenter les propriétés microphysiques sur la verticale des nuages bas et brouillards avec un dispositif instrumental novateur.
Nous avons ici déployé des mesures in-situ sous ballon captif (0-500m) en parallèle des mesures de télédétection active (lidar, radar, radiomètre) pendant l'épisode de brouillard du 6 Janvier 2015.
Ce déploiement permet :

- de comparer les valeurs de réflectivité calculées et mesurées ;
- d'effectuer une fermeture en eau liquide sur toute la couche nuageuse ;
- de quantifier la précision des relations empiriques des propriétés nuageuses.

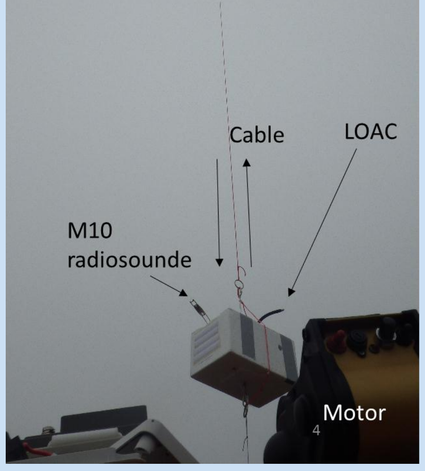
DISPOSITIF INSTRUMENTAL – SPECIFICITE TECHNIQUES – PHOTOS de L'INSTALLATION

Instruments	PI - Network	Variables	Range
Doppler Cloud radar BASTA	J. Delanoë (LATMOS) ACTRIS	Reflectivity (Z ~NxR^6) Doppler velocity(~droplet up/down velocity)	First door at 40m up to 12km Here, 12.5m mode (up to 200m for cirrus cloud)
Ceilometer CL31	M. Haeffelin (IPSL) Meteo-France network	Backscatter profile at 905nm Cloud base height	7,5m up to 6km Resolution 15m
Microwave radiometer HATPRO	JC. Dupont (IPSL) MWRNET, ACTRIS	IWV, LWP Vertical profile of T and RH	- -
Doppler lidar WLS7v2	E. Dupont (CEREA)	3D wind speed	Range : 40-200m Resolution : 10min & 20m
Tethered balloon with - M10 sensor - LOAC sensor	JC. Dupont (IPSL) P. Charpentier (MODEM) JB. Renard (LPC2E)	T/RH Particle size distribution	0-300m or 0-500m agl 0.2-50µm
Diffusometer DF320 Diffusometer PWD22	JC. Dupont (IPSL) Meteo-France network	Horizontal visibility	50m-70km, ground 50m-70km, 20m agl
Hotplate TPS 3100	JC. Dupont (IPSL)	Precipitation rate	> 0,05mm/hr

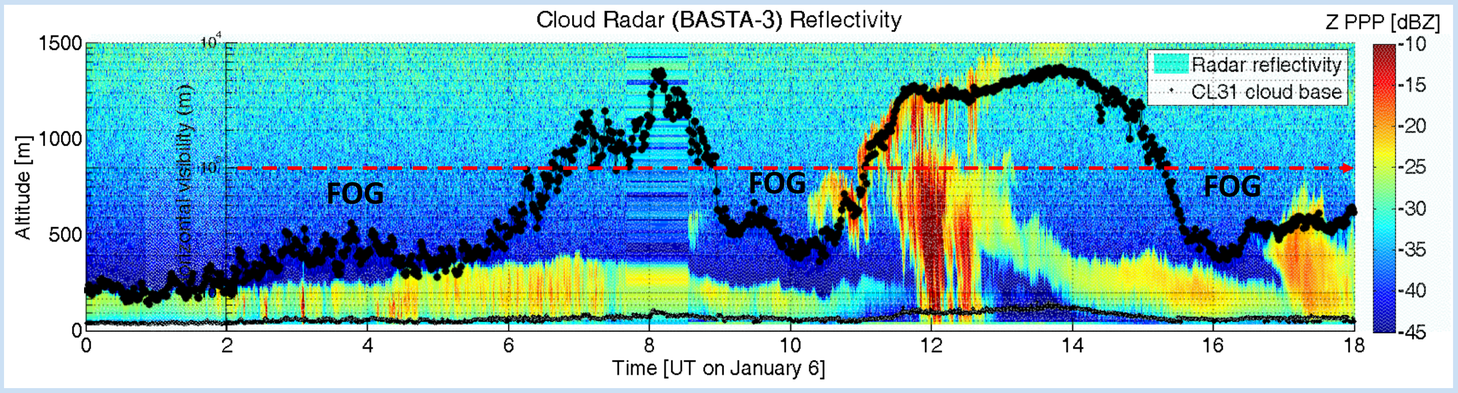
BASTA reflectivity and tethered balloon trajectory

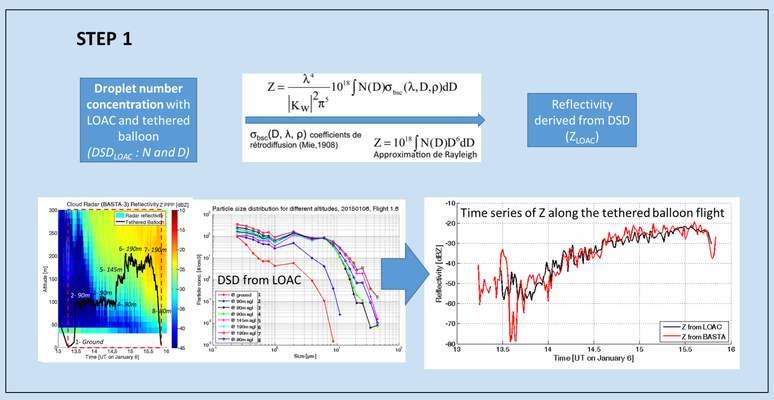


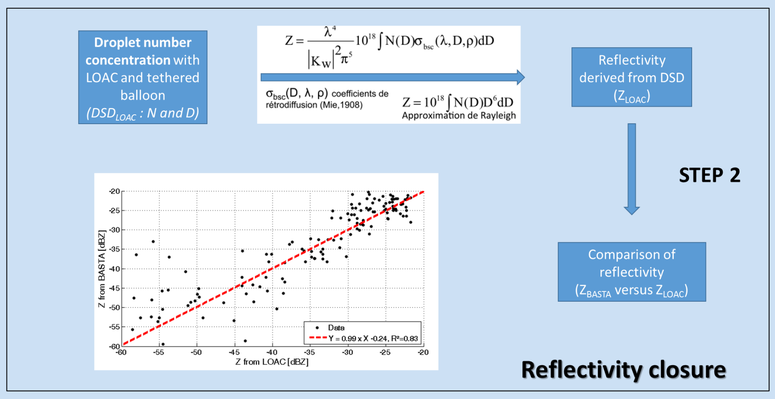
Treuil avec ballon captif

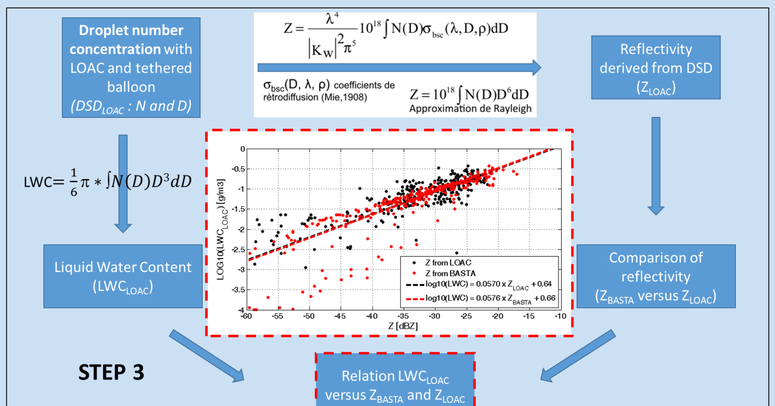


RESULTATS – INTERCOMPARAISONS







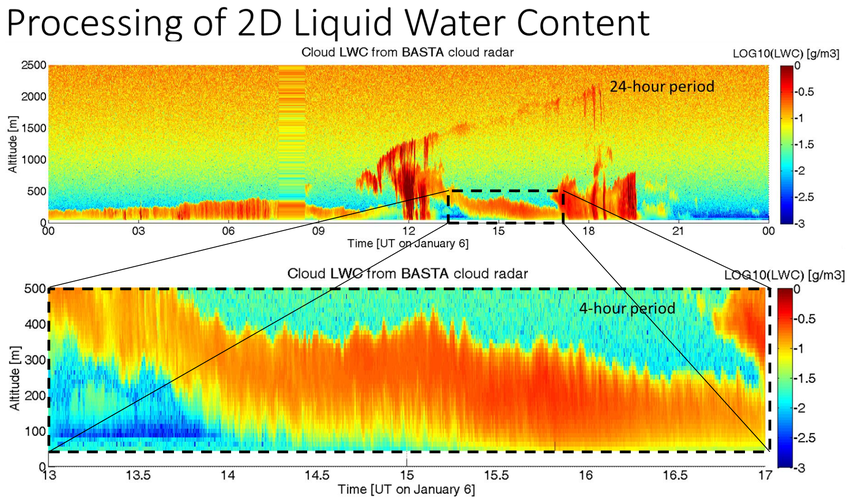


General goal : Liquid water closure experiment using in-situ, active and passive remote sensing instrument

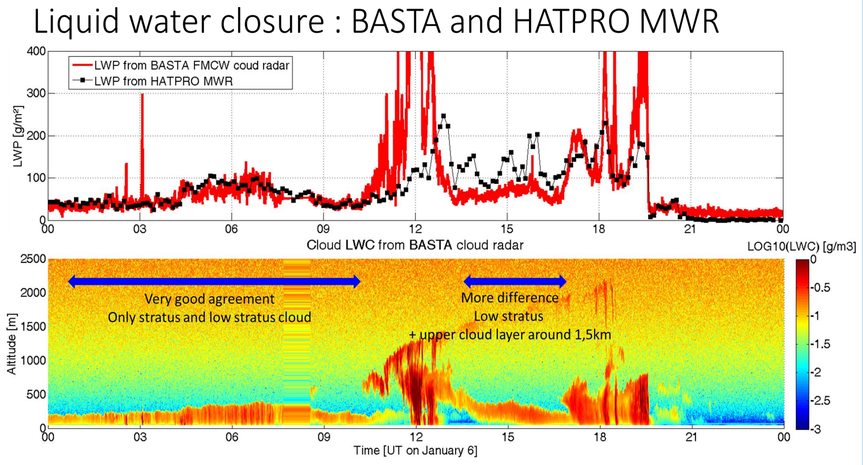
Droplet number concentration with LOAC and tethered balloon (DSD$_{LOAC}$: N and D)
$Z=\frac{\lambda^4}{|K_W|^2\pi^5}10^{18}\int N(D)\sigma_{bsc}(\lambda,D,\rho)dD$
$\sigma_{bsc}(D,\lambda,\rho)$ coefficients de rétrodiffusion (Mie,1908)
$Z=10^{18}\int N(D)D^6dD$ Approximation de Rayleigh
Reflectivity derived from DSD (Z$_{LOAC}$)
$LWC=\frac{1}{6}\pi*\int N(D)D^3dD$
Liquid Water Content (LWC$_{LOAC}$)
Method
Comparison of reflectivity (Z$_{BASTA}$ versus Z$_{LOAC}$)
Relation LWC$_{LOAC}$ versus Z$_{BASTA}$ and Z$_{LOAC}$

14

Processing of 2D Liquid Water Content



Liquid water closure : BASTA and HATPRO MWR



CONCLUSIONS

- **Reflectivity and liquid water closure are successfull** for the case study of January 6th 2015 : very nice agreement between **vertical profile of in-situ sensor of droplet microphysics and active-passive remote sensing instrument**
- **Z-LWC law is validated for the 24hr-period** (with HATPRO MWR LWP data)
- **2D view of LWC**

PERSPECTIVES

- Apply this methodology to other case study coupling in-situ profiles and remote sensing
- Compare microphysical properties derived from this methodology with **LES/1D/variational methodology on low-stratus cloud and fog**
- Compare with other Z-LWC law (ACTRIS WP22 Actions)

REMERCIEMENTS

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